

REMARKS

The present application originally included Claims 1-26. Following a restriction requirement, Claims 1-13 were elected and have now been examined. As such, the non-elected claims, that is, Claims 14-26, have now been cancelled without prejudice to presentation in any subsequent divisional application.

Objections were raised to Claims 2-5, 7-10, 12 and 13 for various informalities. The preamble of each of these claims has been amended in the manner suggested by the Official Action. Additionally, Claims 4 and 8 have been amended to no longer recite "that portion" and to, instead, recite "the medial portion." Additionally, Claim 10 has been amended to clarify that the major surfaces are those of the bonded wafer. Moreover, the dependency of Claim 10 has been amended to now depend directly from independent claim 6 in light of the amendments to independent Claim 6 that are discussed below. Since each of the informalities noted by the Official Action has been addressed, the objections to Claims 2-5, 7-10, 12 and 13 are therefore overcome.

Independent Claim 1 is Patentable

Independent Claim 1, as well as Claims 2-5 which depend therefrom, were the subject of several rejections. In particular, Claims 1-3 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,162,739 to Franz Sumnitsch, et al. Additionally, Claims 1-3 and 5 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent Application Publication No. 2004/0041143 to Gi-Jung Kim, et al. Additionally, dependent Claim 4 was rejected under 35 U.S.C. § 103(a) as being obvious over the Kim '143 publication. As described below, independent Claim 1 has been amended to be further patentably distinct from the cited references, taken either individually or in combination.

In this regard, amended independent Claim 1 is now directed to an intermediate wafer assembly that includes a handle wafer and a bonded wafer with the bonded wafer including a substrate with opposed first and second major surfaces and a peripheral edge extending therebetween. The bonded wafer is attached to the handle wafer such that the first major surface

faces away from the handle wafer and the second major surface faces toward the handle wafer. Additionally, the cross-sectional profile of the edge includes an angled edge segment adjacent the first major surface that extends linearly at a predefined angle relative to a reference plane defined by the first major surface and a curved edge segment that defines a continuous curve extending from the angled edge segment to the second major surface.

Each of the Sumnitsch '739 patent and the Kim '143 publication describes a single semiconductor wafer and not any type of intermediate wafer assembly having both a handle wafer and a bonded wafer attached to the handle wafer as now recited by amended independent Claim 1. Additionally, the Sumnitsch '739 patent fails to teach or suggest a curved edge segment that defines a continuous curve extending from the angled edge segment to the second major surface as set forth by independent Claim 1. Instead, the Sumnitsch '739 patent discloses a semiconductor wafer having chamfered surfaces 6, 7 proximate the opposed major surfaces with a rounded edge surface 8 extending between the opposed chamfered surfaces. Since the rounded edge of the Sumnitsch '739 patent only extends between the opposed chamfered surfaces, the rounded edge does not extend continuously to either major surface as recited by independent Claim 1.

While the Kim '143 publication does disclose a wafer having a chamfered edge portion proximate the bottom surface and a rounded edge extending from the chamfered edge portion to the top surface of the wafer, the Kim '143 patent does not describe the wafer in terms of a bonded wafer that is attached to a handle wafer as now set forth by amended independent Claim 1 and, as such, does not teach or suggest that the rounded portion of the edge extends continuously from the chamfered edge portion to the second major surface that faces toward the handle wafer as also now set forth by amended independent Claim 1.

Since neither the Sumnitsch '739 patent nor the Kim '143 publication teaches or suggests an intermediate wafer assembly as recited by amended independent Claim 1, the rejections of independent Claim 1, as well as Claims 2-5 which depend therefrom, as being anticipated by these references are therefor overcome.

Independent Claim 6 is Patentable

Independent Claim 6, as well as Claims 7-10 which depend therefrom, were also rejected. In particular, the Official Action rejected Claims 6, 7, 9 and 10 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,583,029 to Takao Abe, et al. Additionally, Claim 8 was rejected under 35 U.S.C. § 103(a) as being unpatentable over the Abe '029 patent as described below. Independent Claim 6 has also been amended to be further patentably distinct from the Abe '029 patent. In this regard, independent Claim 6 describes an intermediate wafer assembly to include a handle wafer and a bonded wafer attached to the handle wafer. The bonded wafer includes a first major surface facing away from the handle wafer and a second major surface facing toward the handle wafer. The bonded wafer further includes an angled edge segment adjacent the first major surface that extends linearly at a predefined angle relative to a reference plane defined by the first major surface. The handle wafer and the bonded wafer each include a respective edge extending peripherally thereabout. The edge of each wafer defines a radiused surface that extends continuously to an interface between the handle and bonded wafers. As now recited, amended independent Claim 6 defines the radiused surface of the bonded wafer to extend continuously from the angled edge segment to the second major surface.

The Abe '029 patent describes a method for fabricating a silicon wafer and, in turn, a silicon on insulator (SOI) wafer. As shown in Figures 1 and 7g' as referenced by the Official Action, a bond wafer 1 can be attached to a base wafer 2 with each wafer having opposed major surfaces. Moreover, the edge profile of each wafer can include a linearly chamfered portion proximate the major surface of the respective wafer that faces away from the other wafer as well as a rounded or curved portion proximate the major surface of the respective wafer that faces the other wafer. A vertical edge extends between the linearly chamfered portion and the rounded or curved portion so as to define a cylindrical medial portion of each wafer. In contrast to the intermediate wafer assembly of amended independent Claim 6, however, the Abe '029 patent does not teach or suggest that the radiused surface of the bond wafer extends continuously from the angled edge segment to the second major surface, that is, the major surface that faces the handle wafer. Instead, the rounded or curved portion and the linearly chamfered portion of the bond wafer of the Abe '029 patent are separated by a vertical edge such that the radiused surface

does not extend continuously from the angled edge segment as recited by amended independent Claim 6. Moreover, the Abe '029 patent would not suggest any increase in the rounded or curved edge portion as would be required in order for the rounded or curved edge portion to extend continuously from the linearly chamfered portion to the second major surface. In this regard, one of the objectives of the methods described by the Abe '029 patent is to reduce (i.e., not increase) the polishing sag which is the mechanism by which the rounded or curved edge portion is produced. See column 1, lines 9-11 and column 14, lines 2-4 of the Abe '029 patent. Since amended independent Claim 6 is not taught or suggested by the Abe '029 patent, the rejections of Claim 6, as well as Claims 7-10 which depend therefrom, are therefore overcome.

Independent Claim 11 is Patentable

As to the remaining claims, independent Claim 11 and dependent Claims 12 and 13 were rejected as being obvious over various combinations of references. In particular, Claims 11 and 12 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,152,857 to Tatsuo Ito, et al. in view of U.S. Patent No. 6,900,522 to Hideki Kurita, et al. Additionally, dependent Claim 13 was rejected under 35 U.S.C. § 103(a) as being unpatentable over the Ito '857 patent and the Kurita '522 patent in further view of the Abe '029 patent. As described below, independent Claim 11 is patentably distinct from the cited references, taken either individually or in combination and, as such, the rejections of independent Claim 11, as well as the claims which depend therefrom, are therefore respectfully traversed.

Independent Claim 11 is directed to an intermediate wafer assembly including a handle wafer and a bonded wafer attached to the handle wafer. The bonded wafer has a first major surface facing away from the handle wafer and a second major surface proximate the handle wafer. The bonded wafer also includes a peripheral edge extending between the first and second major surfaces and defining a cross-sectional profile which includes a first angled edge segment adjacent the first major surface that extends linearly at a predefined angle relative to a reference plane defined by the first major surface, a second angled edge segment adjacent the second major surface that extends linearly at a predefined angle relative to a reference plane defined by the second major surface and a curved edge segment that defines a continuous curve extending

between the first and second angled edge segment. Independent Claim 11 also states that the second angled edge segment is at least 50% smaller in the radial direction than the first angled edge segment such that the diameter of the second major surface is correspondingly larger than the diameter of the first major surface.

The Ito '857 patent describes a method for fabricating an SOI structure, including a base wafer 21a and a bonding wafer 21b. As shown, the base wafer can include linearly chamfered portions adjacent the opposed major surfaces. Similarly, the bonded wafer can include a linearly chamfered portion adjacent the major surface that faces away from the base wafer. In some embodiments, the bonded wafer also includes a linearly chamfered portion adjacent a major surface that faces towards the base wafer. In each instance, however, the edge profile of both the base wafer and the bonding wafer includes a linear, e.g., vertical, portion extending between the opposed chamfered portions (or between a chamfered portion and the opposed major surface in the embodiment of Figures 1a and 1b) and does not teach or suggest any type of curved edge segment defining a continuous curve between the first and second angled edge segments as set forth by independent Claim 11.

Additionally, the Ito '857 patent does not teach or suggest a second angled edge segment that is at least 50% smaller in a radial direction than a first angled edge segment such that the second major surface is correspondingly larger than the diameter of the first major surface as also set forth by independent Claim 11. In this regard, the Official Action questions the criticality of the numeric relationship, that is, the second angled edge segment being at least 50% smaller in a radial direction than the first angled edge segment. While the present application does not highlight the criticality of a particular numerical value, the present application does describe the importance of the diameter of the second major surface being larger than the diameter of the first major surface which is accomplished by the second angled edge segment being smaller in the radial direction than the first angled edge segment. In this regard, it is noted that the portion of the bonded wafer proximate the second major surface will eventually form the active layer in which various semiconductor devices are defined. With this in mind, page 3, lines 19-22 of the present application notes the desirability of fabricating wafers having larger active layers. Moreover, page 3, lines 27-30 notes that the edge profile of a wafer in accordance with

the present invention “permits the edge of the wafer to be ground so as to form a larger active layer without causing the wafer to be undersized, thereby advantageously permitting the resulting wafer to be processed in a conventional fashion.” Similarly, page 8, lines 1-4 of the present application states that “the improved cross-sectional profile of the edge of the wafer of the present invention permits the resulting wafer to have a conventional size while increasing the size of the active layer without requiring that the wafer initially be oversized.” Moreover, page 10, lines 29 and 30 of the present application notes that “it is desirable in many respects to define the edge profile of the wafer 30 in a manner that maximizes the size of the second major surface 36, i.e., the major surface that will be attached to the other wafer of an SOI wafer.” Following this statement, the present application proceeds to describe an embodiment of independent Claim 11 in which the size of the second major surface is increased by fabricating the wafer such that the second major surface is correspondingly larger than the diameter of the first major surface as a result of the second angled segment being smaller in a radial direction than the first angled edge segment. See page 11, lines 1-19. As a result, it is submitted that the present application does describe the importance of the second major surface being larger than the diameter of the first major surface which is brought about by the second angled edge segment being smaller in a radial direction than the first angled edge segment. In contrast to this advantageous aspect of independent Claim 11, the Ito ‘857 patent does not teach or suggest that the second angled edge segment be smaller than the first angled edge segment or that the respective diameters of the first and second major surfaces be different from one another.

As to the Kurita ‘522 patent, a semiconductor wafer is described having a chamfered corner with an arcuately shaped portion 22 adjacent to the chamfered portion. Unlike the cross-sectional profile of the edge of independent Claim 11, however, the arcuately shaped portion of the semiconductor wafer of the Kurita ‘522 patent does not define a continuous curve extending between first and second angled edge segments. Instead, the arcuately shaped portion merely connects or blends the chamfered corner portion into a linear, e.g., vertical, portion of the edge and does not extend continuously to the chamfered corner proximate the opposed major surface. Additionally, the Kurita ‘522 patent fails to teach or suggest that the second angled edge segment is smaller, such as by being 50% smaller, in a radial direction than the first angled edge segment

such that the diameter of the second major surface is correspondingly larger than the diameter of the first major surface as set forth by independent Claim 11 and the importance of which is described by the present application as noted above.

Finally, the Abe '029 patent also fails to teach or suggest a curved edge segment defining a continuous curve extending between first and second angled edge segments as set forth by independent Claim 11. Instead, the curved edge portion of the Abe '029 patent is adjacent one of the major surfaces and does not extend between first and second angled edge segments that are themselves adjacent respective major surfaces. Further, the Abe '029 patent does not teach or suggest that the bonded wafer have a first angled edge segment adjacent to a second major surface that faces the handle wafer so that the Abe '029 patent also fails to teach or suggest a second angled edge segment that is smaller, such as 50% smaller, in a radial direction than the first angled edge segment as set forth by independent Claim 11. Instead, the curved or rounded portion created by the polishing sag is disclosed to be adjacent the major surfaces that face the base wafer.

Since none of the Ito '857 patent, the Kurita '522 patent, or the Abe '029 patent teach or suggest either a curved edge segment extending continuously between first and second angled edge segments or a second angled edge segment that is at least 50% smaller in a radial direction than a first angled edge segment as set forth by independent Claim 11, no combination of the cited references teaches or suggests these same features. As such, the rejections of independent Claim 11, as well as Claims 12 and 13 which depend therefrom, are therefore overcome.


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CONCLUSION

In view of the amendments to the claims and the foregoing remarks, it is respectfully submitted that all of the claims of the present application are in condition for immediate allowance. It is therefore respectfully requested that a Notice of Allowance be issued. The Examiner is encouraged to contact Applicant's undersigned attorney to resolve any remaining issues in order to expedite examination of the present application.

It is not believed that extensions of time or fees for net addition of claims are required, beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,


Guy R. Gosnell
Registration No. 34,610

Customer No. 00826
ALSTON & BIRD LLP
Bank of America Plaza
101 South Tryon Street, Suite 4000
Charlotte, NC 28280-4000
Tel Charlotte Office (704) 444-1000
Fax Charlotte Office (704) 444-1111

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